



A trial of a new Autonomous Underwater Vehicle in a tidally restricted coastal lagoon



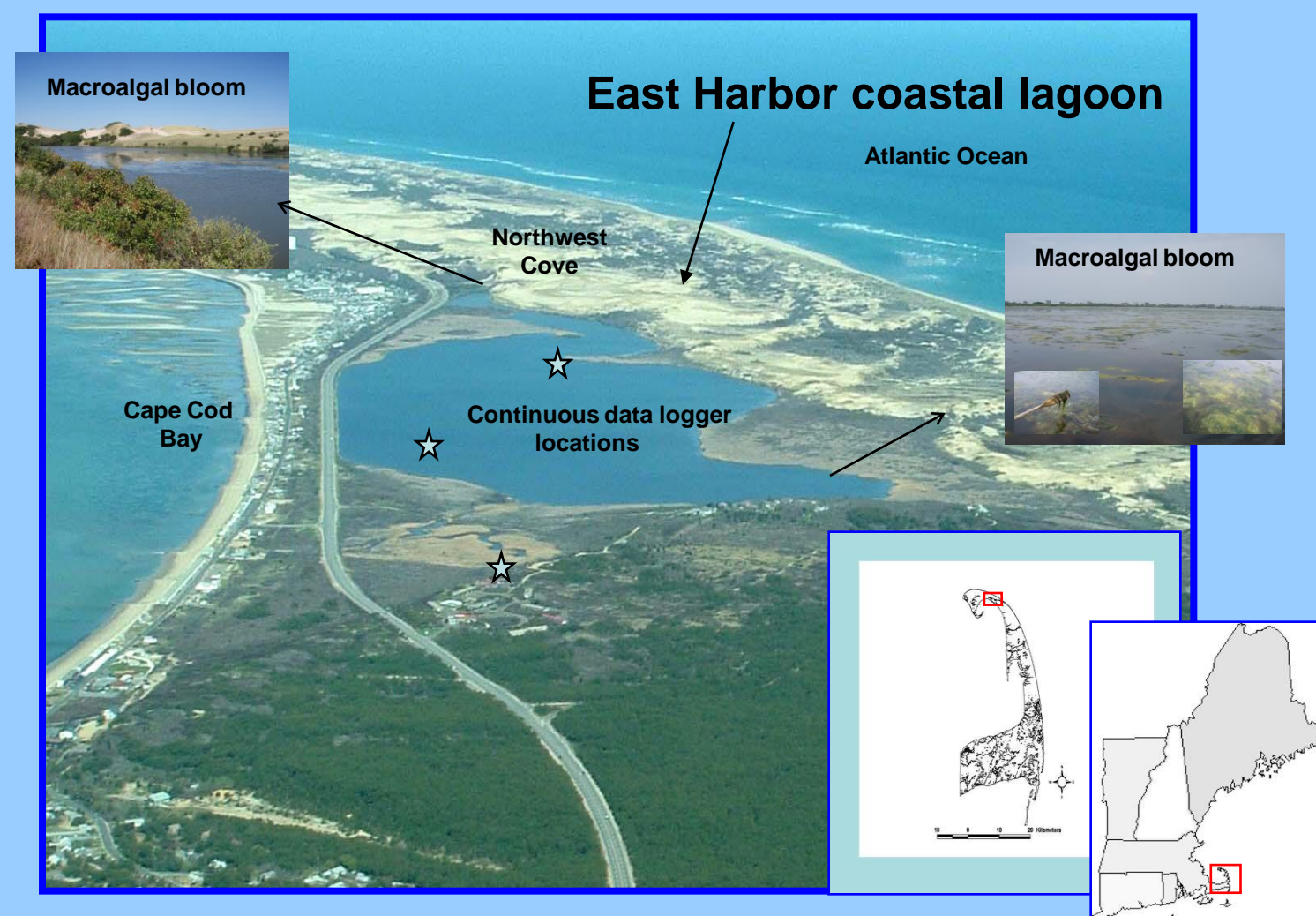
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BACKGROUND

The 350-acre East Harbor coastal lagoon located within the Cape Cod National Seashore in Truro, MA has been monitored continuously, following observations of an oxygen depletion and fish kill in 2001. The 4-ft by 700-ft-long culverts connecting the East Harbor system to Cape Cod Bay have been open continuously since November 2002 in an attempt to improve tidal flushing and aeration. With these valves open, salinity has risen from about 4 to 25 ppt in the lagoon. With observations of 1) a soft shell clam die off due to temperatures above 30 degrees Celsius and super-saturation of dissolved gas (>400%) during the day and near oxygen depletion during the night, and 2) a proliferation of macroalgae and cyanobacteria in 2006, more intensive monitoring was needed for a better understanding of the dynamics of the system. The *EcoMapper* AUV was utilized to provide a more comprehensive data set and greater spatial coverage.

STUDY SITE



METHODS

CONTINUOUS SONDE DATA OUTPUT

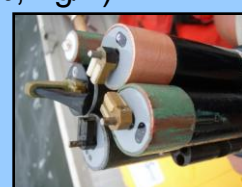
Data Collection:

- 3 fixed locations within 350 acre water body
- ~0.5 meters off bottom at each site
- ~5 months of data collection
- Data collection interval of 20-30 minutes

Data collected:

- Date, Time

- Water Temperature (°C)
- Conductivity (uS/cm)
- Salinity (ppt)
- ROX Dissolved Oxygen (%/mg/L)
- Depth sounding
- pH
- Turbidity
- Chlorophyll-a
- Blue Green Algae



EcoMapper AUV DATA OUTPUT

Data Collection:

- Surface sweep of 350 acre water body
- ~8 miles of mission lines
- ~3.5 hours to run
- Data collection interval of 1 second

Data Collected:

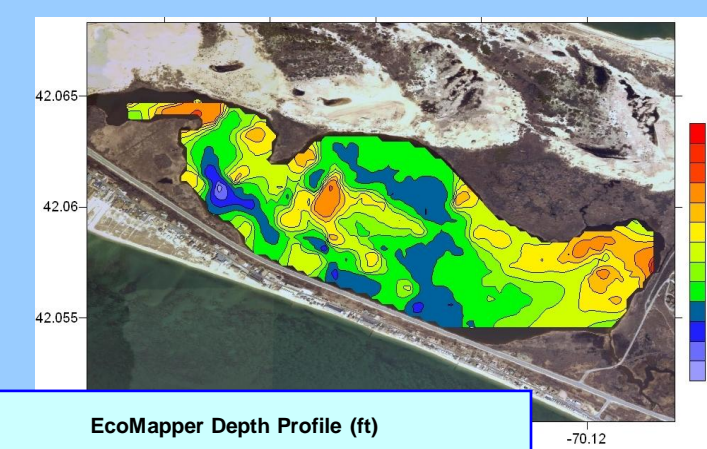
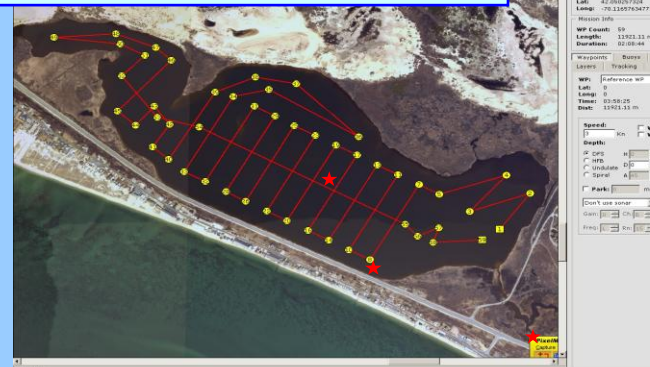
- Date, Time
- Latitude and Longitude
- Water Temperature (°C)
- Conductivity (uS/cm)
- Salinity (ppt)
- ROX Dissolved Oxygen (%/mg/L)
- Depth sounding
- pH
- Turbidity
- Chlorophyll-a
- Blue Green Algae



East Harbor has been monitored continuously with multi-parameter YSI 6600EDS sondes since 2004 at fixed locations in the lagoon (see above). In addition to the two fixed continuous YSI 6600EDS sondes in the lagoon, a new unique tool for wider spatial resolution, the *EcoMapper* AUV (Autonomous Underwater Vehicle) was implemented in this years study.

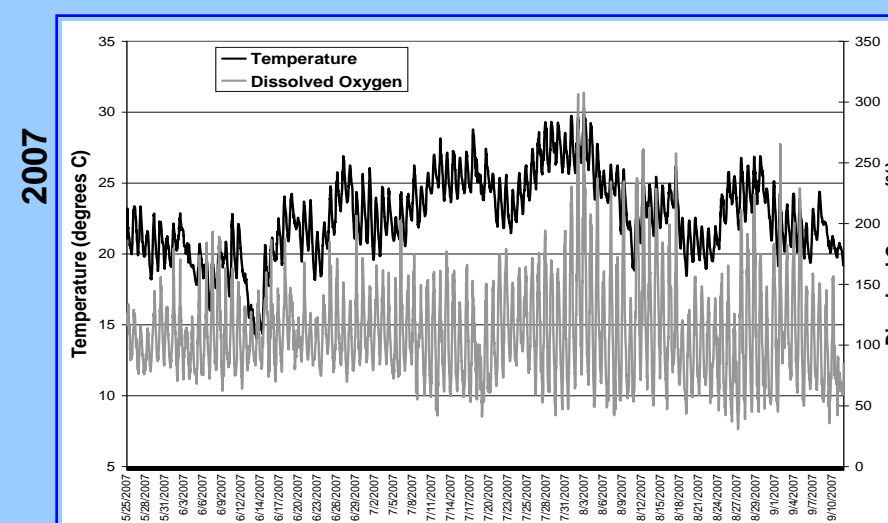
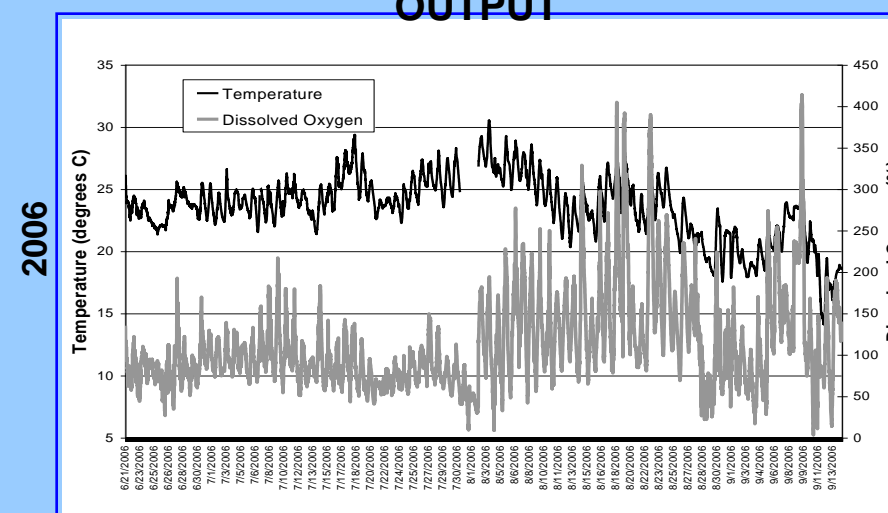
The *EcoMapper* is a mobile sensor platform that records GPS position, water quality parameters and bathymetric data at 1 Hz while underway. Two missions were deployed in August and September 2007. Each mission took 5 minutes to set up and 3.5 hours to complete. Once retrieved the data was downloaded and imported into profiles using Surfer8 software.

EcoMapper Sampling Mission



EcoMapper Depth Profile (ft)

CONTINUOUS SONDE DATA OUTPUT



RESULTS

Continuous sonde data to the left showing temperature and dissolved oxygen concentrations for 2006 and 2007 at the same fixed location

EcoMapper profiles to the right provided a clearer picture of the difference in just two of the chemical and physical parameters measured

During the 2007 field season, the main body of the lagoon remained clear of most macroalgae and cyanobacteria

In situ monitoring assessed biological productivity by including sampling for chlorophyll-a and blue-green algae and analyzing samples at the lab by filtration, extraction, and fluorometric technique.

The map to the left displays the average results of the monthly (Jan-Aug 2007) sampling for chlorophyll-a (ug/L).

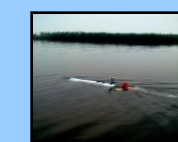
The *EcoMapper* profile to the right of the main lagoon and a portion of the Northwest cove was able to capture similar concentrations of chlorophyll-a from one 3.5 hour mission in August 2007.

CONCLUSIONS

The continuous monitoring at fixed locations throughout the lagoon has proven beneficial to our knowledge of the temporal changes in this system.

The use of an autonomous mobile platform has demonstrated the ability to capture spatial resolution that our existing fixed instrumentation would be unable to obtain.

The *EcoMapper* has provided more insight into the lagoon dynamics by generating high spatial resolution maps of water quality parameters.



Along with the data collected from the continuous sites at fixed locations, the profiles generated by the *EcoMapper* will enhance the seasonal data set.

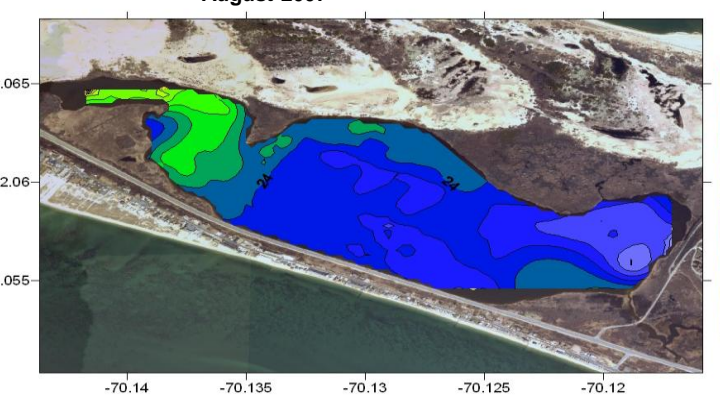
Future implementation of this technology will:

- Allow us to assess seasonal changes throughout the system
- Assist in making more comprehensive management decisions

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EcoMapper AUV DATA OUTPUT

EcoMapper Surface water temperature (C) Profile August 2007



EcoMapper Dissolved Oxygen (% saturation) Profile August 2007

